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ASSESSMENT OF IMPULSIVITY AND THE DEVELOPMENT OF SELF-CONTROL IN STUDENTS WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

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We examined a combined approach of manipulating reinforcer dimensions and delay fading to promote the development of self-control with 3 students diagnosed with attention deficit hyperactivity disorder. First, we administered a brief computer-based assessment to determine the relative influence of reinforcer rate (R), reinforcer quality (Q), reinforcer immediacy (I), and effort (E) on the students' choices between concurrently presented math problems. During each session, one of these dimensions was placed in direct competition with another dimension (e.g., RvI involving math problem alternatives associated with high-rate delayed reinforcement vs. low-rate immediate reinforcement), with all possible pairs of dimensions presented across the six assessment conditions (RvQ, RvI, RvE, QvI, QvE, IvE). The assessment revealed that the choices of all 3 students were most influenced by immediacy of reinforcement, reflecting impulsivity. We then implemented a self-control training procedure in which reinforcer immediacy competed with another influential dimension (RvI or QvI), and the delay associated with the higher rate or quality reinforcer alternative was progressively increased. The students allocated the majority of their time to the math problem alternatives yielding more frequent (high-rate) or preferred (high-quality) reinforcement despite delays of up to 24 hr. Subsequent readministration of portions of the assessment showed that self-control transferred across untrained dimensions of reinforcement.

DESCRIPTORS: attention deficit hyperactivity disorder, self-control, impulsivity, delay, concurrent schedules

An estimated 3% to 5% of children in the United States meet the current diagnostic criteria for attention deficit hyperactivity disorder (ADHD), making it one of the most prevalent disorders in the school-aged population (American Psychiatric Association, 1994; Barkley, 1998). A majority of these children have academic skill deficits; in fact, to a large extent, the diagnostic criteria for ADHD were based on their predictive validity for educational impairment (McBurnett, Lahey, & Pfiffner, 1993). One of the diagnostic criteria for ADHD is impulsivity (American Psychiatric Association, 1994). Although impulsivity is typically diagnosed using rating scales based on teacher and parent report, it has been operationally defined in basic and applied behavioral research as choices between concurrently available response alternatives that produce smaller immediate reinforcers rather than larger delayed reinforcers (Ainslie, 1974; Logue, Peña-Correal, Rodriguez, & Kabela, 1986; Neef, Mace, & Shade, 1993; Rachlin, 1974). Conversely, self-control is defined as choices that produce relatively greater yields at a later point in time.

Research with both human and nonhuman animals has shown that self-control can

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be developed by gradually increasing the delay to the larger reinforcer (Dixon et al., 1998; Logue, Rodriguez, Peña-Correal, & Mauro, 1984; Mazur & Logue, 1978; Ragotzy, Blakely, & Poling, 1988; Schweitzer & Sulzer-Azaroff, 1988). Dixon et al., for example, established self-control in 3 adults with developmental disabilities by first making both the smaller and larger reinforcers for desired behaviors available immediately, and then progressively increasing the delay for the schedule associated with the larger reinforcer only.

Research using this approach has been limited to schedules associated with different amounts of a reinforcer. In some cases, however, self-control may involve other reinforcer dimensions, such as forgoing access to immediate reinforcers in favor of delayed access to reinforcers that are of higher quality. Thus, another approach to the development of self-control is to manipulate reinforcer dimensions to compete with reinforcer immediacy.

Neef et al. (1993) examined this approach with 2 students who demonstrated impulsivity in choices between concurrently available sets of math problems (i.e., when the delays to reinforcer access differed between the response alternatives, the students' choices were biased toward the response alternative yielding lower rate immediate reinforcement rather than higher rate delayed reinforcement). In their second study, Neef et al. arranged delayed access to reinforcers that were higher quality (more preferred) and delivered at a higher rate for one of the two sets of math problems relative to the other (i.e. response options associated with high-quality, high-rate, delayed reinforcement vs. low-quality, low-rate, immediate reinforcement). This condition was alternated with one involving immediate access to lower quality reinforcers delivered at a higher rate for one set of math problems relative to the other (i.e., low-quality, high-rate, immediate reinforcement vs. high-quality, low-rate, delayed reinforcement). The results showed that, for 1 of the students, reinforcer quality overrode the effects of both reinforcer rate and delay to reinforcer access (i.e., self-control was established by increasing the quality of the delayed reinforcers), whereas the other student continued to respond to the alternative associated with immediate reinforcer access.

Barkley (1997) asserts that children with ADHD are deficient in the capacity for their behavior to be governed by temporally remote contingencies, and that efforts to promote the development of self-control with these children are therefore unlikely to be successful. However, assessment of the relative influence of different reinforcer dimensions such as rate, quality, and delay on an individual's choices (Neef & Lutz, 2001b; Neef et al., 1993; Neef, Shade, & Miller, 1994) may suggest how those dimensions could be combined or manipulated to promote self-control.

In the present study we used an analogue task to examine a combined approach of manipulating reinforcer dimensions and delays (concurrent fixed-duration/progressive-duration reinforcement schedules) on the development of self-control by 3 students diagnosed with ADHD. First, we conducted a brief computer-based assessment involving choices of concurrently presented math problems associated with competing reinforcer dimensions (Neef & Lutz, 2001b) to assess impulsivity (choices controlled primarily by reinforcer immediacy) as well as the relative influence of other dimensions (i.e., variables that do not define impulsivity but that may be influential in promoting self-control). Second, we implemented a self-control training procedure in which (a) immediate reinforcement competed with another influential dimension identified by the assessment (high rate or quality of reinforcement), and (b) the delay for the higher rate or higher quality reinforcer alternative was progressively increased. Third, we readministered portions of the assessment to examine choices patterns reflecting impulsivity versus self-control with untrained dimensions.

METHOD

Participants

Participants were 3 students with a diagnosis of attention deficit disorder (Kent) or ADHD (Raoul and Lynn) who attended a large urban area public elementary school. Kent was an 11-year-old African American boy who had also been diagnosed with developmental handicaps and was receiving special education services in a self-contained classroom. At the time of the study he was not receiving medication. He scored within the clinical range for inattentiveness and in the high normal range for overactivity on the Achenbach Child Behavior Profile—Teacher Report Version. His IQ score on the Wechsler Intelligence Scale for Children (3rd ed.; WISC-III) was 71. His school records indicated that he was performing below grade level in all academic areas and that he had been removed from the classroom for discipline problems on five occasions during the previous 2 years.

Raoul was a 9-year-old African American boy who had been referred for special education services. He was not receiving medication at the time of the study. His IQ score on the WISC-III was 79. His school records indicated that he was performing below grade level in math.

Lynn was a 9-year old African American girl. At the time of the study, she was prescribed 10-mg of methylphenidate once per day and was receiving special education services. Her school records indicated that she was performing below grade level in all academic areas and that she had been removed from the classroom for discipline problems on three occasions during the past year.

Apparatus and Setting

The experimental task was conducted on a Dell computer (Inspiron® 3800 or 5000c) using a software program similar to one described by Neef and Lutz (2001b). The program provided a menu from which the experimenter selected the specifications for each of two sets of math problems. The specifications consisted of the type (addition, subtraction, multiplication, or division) and level of math problems, the schedules of reinforcement (variable-interval [VI] 30 s, VI 60 s, or VI 90 s), backup reinforcer delivery schedules (e.g., "end of the session" or "next session"), and backup reinforcer repositories (Store A and Store B). The computer program was equipped to record for each problem set the number of points obtained, the number of problems attempted, the number of problems completed accurately and inaccurately, and the cumulative time spent on each problem set. The study was conducted 3 to 5 days per week in a secluded area of the school with only the experimenter and the student present.

Procedure, Conditions, and Experimental Design

During each session throughout all phases of the study, the student completed a 5-min practice session followed by a 10-min test session. The task was the same as that described by Neef and Lutz (2001b). During each trial, two different-colored problems (one from each set selected from the menu) appeared on the monitor (choice screen). The response effort required for problem completion was evident from the problems displayed. The choice screen also displayed under each problem the cumulative number of reinforcers (points) obtained from that problem set, the store from which items could be purchased with the points earned (reinforcer quality), and when (reinforcer delay). The student then selected either the Set

Table 1
Competing Dimensions across Assessment Conditions

	Baseline							
	R		Q		I		E	
	Set 1	Set 2	Set 1	Set 2	Set 1	Set 2	Set 1	Set 2
Rate of reinforcement (R)	High	Low	Med.	Med.	Med.	Med.	Med.	Med.
Quality of reinforcement (Q)	Med.	Med.	High	Low	Med.	Med.	Med.	Med.
Immediacy of access to reinforcement (I)	Imm.	Imm.	Imm.	Imm.	Imm.	Delay	Imm.	Imm.
Response effort (E)	Med.	Med.	Med.	Med.	Med.	Med.	Low	High

1 or Set 2 math problem using a mouse pointer. The choice response produced only the selected problem on the screen and a representation of a small clock that showed how much time was left to complete the problem. The problem remained on the screen until the student entered the correct answer from the keyboard or the preset time of 30 s elapsed with no response. After a correct response, or if the time ran out before the student entered an answer, the choice screen appeared with two new problems. Following an incorrect response, the words "try again" appeared on the screen, and the computer presented the same problem. Different auditory stimuli signaled reinforcer delivery for Set 1 and Set 2 problems according to the schedule in effect for the problem set. During the 5-min practice preceding each test session, the student was required to sample both alternatives to ensure contact with the respective reinforcement schedules.

The percentage of time allocated to the respective problem sets served as the dependent variable. The assessment phase was used to identify relative sensitivities to response alternatives associated with competing dimensions. This information was then used to establish reinforcer dimensions for the self-control training phase during which the delays for a competing influential dimension were reduced and then progressively increased to maximum levels. The final phase of the study consisted of a partial replication of the assessment phase in which reinforcer immediacy competed with the remaining two dimensions.

Assessment. Assessment consisted of baseline, initial assessment, and replication involving four dimensions (rate, quality, immediacy, and effort). The assessment was the same as that described in Neef and Lutz (2001b), except that a baseline was first conducted to establish the student's sensitivity to each dimension in isolation (higher vs. lower level of the dimension). For example, to determine sensitivity to rate of reinforcement, a VI 30-s schedule was programmed for Set 1 problems and a VI 90-s schedule was programmed for Set 2 problems, while quality, effort, and immediacy remained equal for both problem sets. This was done to confirm that the student's responding was sensitive to the favorable level of the dimension (e.g., problems associated with a higher rate of reinforcement).

Baseline was followed by an initial assessment comprised of six conditions (conducted in random order) as depicted in Table 1. During each condition, one of the dimensions (reinforcer rate, quality, immediacy, or response effort) was placed in direct competition with another dimension (the assignment of dimensions to Set 1 or Set 2 problems varied). For example, RvI involved math problem alternatives associated with high-rate delayed reinforcement versus low-rate immediate reinforcement. Across the six assessment conditions, all possible pairs of

Table 1
(Extended)

R/Q		R/I		R/E		Q/I		Q/E		I/E	
Set 1	Set 2	Set 1	Set 2	Set 1	Set 2	Set 1	Set 2	Set 1	Set 2	Set 1	Set 2
High	Low	High	Low	High	Low	Med.	Med.	Med.	Med.	Med.	Med.
Low	High	Med.	Med.	Med.	Med.	High	Low	High	Low	Med.	Med.
Imm.	Imm.	Delay	Imm.	Imm.	Imm.	Delay	Imm.	Imm.	Imm.	Imm.	Delay
Med.	Med.	Med.	Med.	High	Low	Med.	Med.	High	Low	High	Low

dimensions were presented (RvQ, RvI, RvE, QvI, QvE, IvE).

Rate (R) refers to the concurrent schedules of reinforcement in effect for the respective sets of problems. A VI 30-s schedule was used for the high value, a VI 60-s schedule was used for the medium value, and a VI 90-s schedule was used for the low value.

Quality (Q) refers to the student's relative preference for the reinforcers associated with the two respective problem sets, based on his or her ranking of available reinforcers during a preference assessment (see Neef & Lutz, 2001a, and Neef et al., 1994, for a description). Available rewards included a wide variety of tangible items (e.g., small toys, snacks), coupons for extra time in a preferred activity (e.g., playing computer games alone), and extra attention (e.g., playing a game with the experimenter, a certificate of task performance designed to solicit praise). The first to fifth favorite items served as the high-quality reinforcers (Store A). The remaining five items served as the low-quality reinforcers (Store B). (Subsequently, a control procedure was used for Lynn in which a low-quality confederate item, such as a paper clip, was included among the items to be ranked to ensure the integrity of the rankings.) When reinforcer quality was not a competing dimension, two sets of five identical items were used as reinforcers. During each session, points earned on the respective response alternatives could be used to purchase any item from the designated store. Items were placed in the labeled stores, visible to the student, before each session. Items were identically priced such that one to three items could typically be purchased during a session.

Immediacy (I) refers to whether access to reinforcers earned for the respective set of problems was immediate (at the end of the session) or delayed (immediately preceding the next session). If the student earned enough points for the delayed reinforcer, he or she was given a receipt for delayed delivery of the reward. Sessions in which reinforcer immediacy was a competing dimension were not conducted on Fridays so that the delay duration was not extended beyond 24 hr.

Effort (E) refers to the relative ease with which math problems from the respective sets could be completed, as determined by pretest performance (rate and accuracy) on samples of different types of problems (see Neef & Lutz, 2001a, for a description). Low-effort problems were subtraction problems with answers ≤5 for Kent, addition problems with sums of 1 to 5 for Raoul, and addition problems with sums of 5 to 10 for Lynn. Medium-effort problems were addition problems with sums of 5 to 10 for Kent, addition problems with sums of 1 to 5 for Raoul, and subtraction problems with answers ≤9 for Lynn. (Low- and medium-effort problems were the same for Raoul because of the limited range of his math skills.) High-effort problems were double digit plus single digit addition with no regrouping, subtraction problems with answers ≤ 5, and double digit subtraction with no regrouping for Kent, Raoul, and Lynn, respectively. When effort was not a competing dimension, problems of the same type and level of difficulty were presented for both sets.

Selected conditions, including the most influential dimension, were replicated to strengthen internal validity. The design was an adaptation of a brief functional analysis similar to that used by Cooper, Wacker, Sasso, Reimers, and Donn (1990). However, we did not conduct a parametric analysis, and thus assessment results were limited to the specific values used for each dimension relative to another.

Self-control training. Immediacy (the most influential dimension for all 3 students) and the next most influential dimension, as determined by the assessment, competed while the other two dimensions were equal for each set of problems. For Kent and Lynn, immediacy competed with quality (i.e., the math problem alternatives were those associated with high-quality delayed reinforcement vs. low-quality immediate reinforcement). Reinforcer quality was determined in the same manner as during the assessment. For Raoul, immediacy competed with rate. That is, the math problem alternatives were those associated with a high rate of reinforcement (VI 30 s) with delayed delivery of reinforcers versus a low rate of reinforcement (VI 90 s) with immediate delivery. The first session (baseline) replicated the assessment condition for the above dimensions (IvQ or IvR) in which the delay to reinforcer access was at maximum value (24 hr). Subsequently, the reinforcer delay for the competing dimension was reduced to 15 min and then was systematically increased as the student met a criterion of at least 70% time allocation to that alternative for two consecutive sessions. The increases were established in increments (e.g., 30 min, 45 min) that coincided with the student's schedules (e.g., recess, lunch, end of school day) to avoid interrupting their classroom activities. For Lynn, the return to baseline (24 hr) delay resulted in increased time allocation to the immediate reinforcer alternative. Therefore, the delay was reduced to the previous level and increased more gradually. The criterion for termination of the self-control phase was at least 70% of time allocation to the set of problems associated with the maximum (24 hr) delayed delivery of reinforcers.

Postassessment. To determine the extent to which self-control training resulted in increased time allocation to other dimensions that competed with immediacy of reinforcement, we conducted a partial replication of the assessment phase. Specifically, we readministered the assessment conditions in which reinforcer immediacy competed with the dimensions not used during self-control training (RvI and IvE for Kent and Lynn; QvI and IvE for Raoul).

RESULTS

Figure 1 shows the percentage of time allocation to the response alternatives across assessment, self-control training, and postassessment conditions for each of the 3 students.[1] For ease of interpretation, the assessment conditions are presented in identical order.

Kent

Assessment. During baseline when all dimensions were constant and only one dimension differed in value across the two alternatives, Kent allocated the majority of his time to problems associated with higher

[1] For conditions involving effort, we also analyzed the proportion of easy versus difficult problems performed correctly. In most cases, there was close correspondence between the proportion of easy versus difficult problems correct and the proportion of time allocated to those respective problems. These data are available from the first author.

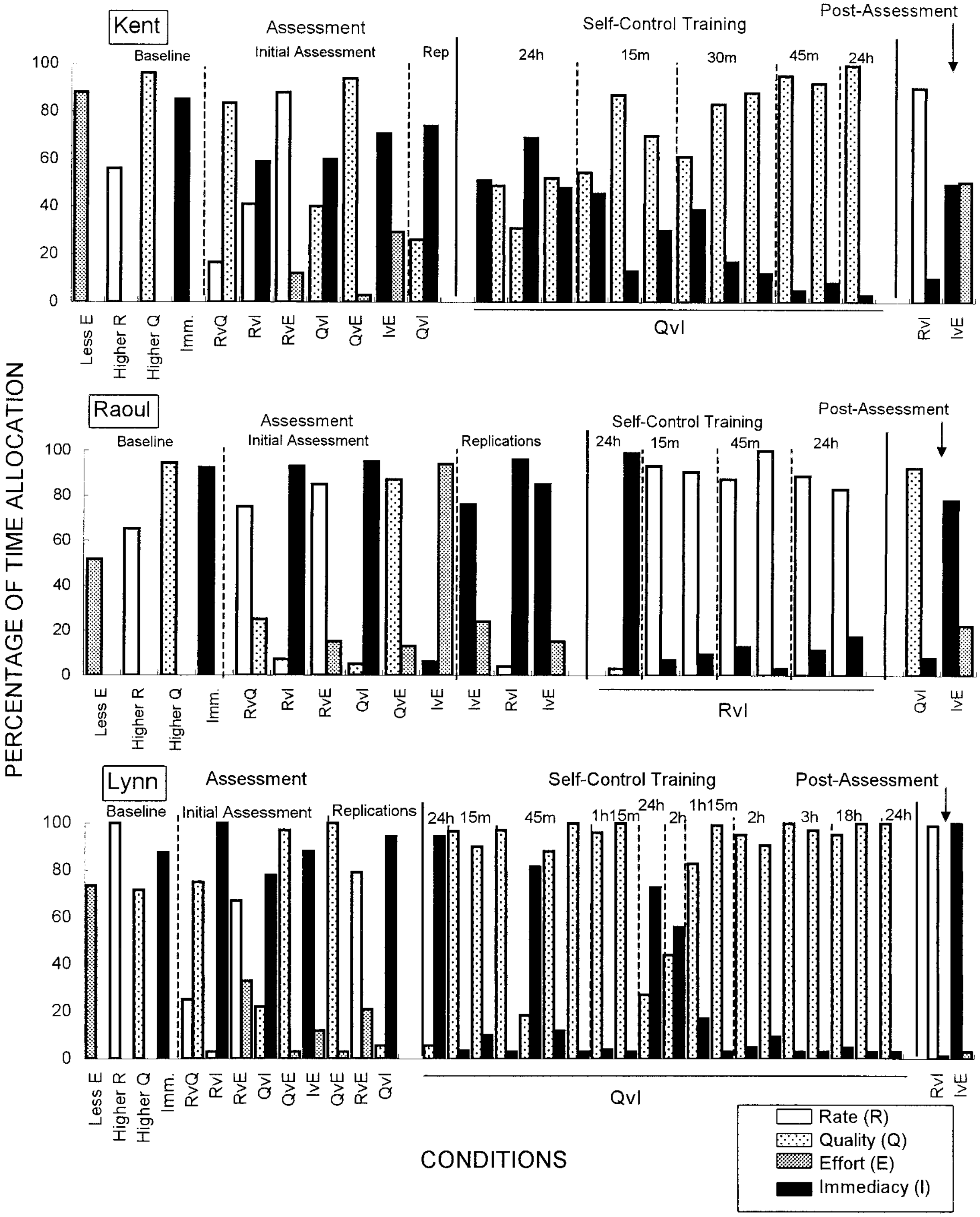

Figure 1. The percentage of time allocation to problem alternatives (summing to 100 within each pair) across conditions of assessment, self-control training, and postassessment phases for Kent, Raoul, and Lynn.

quality reinforcement, more immediate access to reinforcement, less effort, and a higher rate of reinforcement (range, 56% to 96%). That is, when the response alternatives did not compete on dimensions but on values of a single dimension, responding was biased toward the alternative producing the most favorable value (time allocation to the other alternative is not shown, because it was the converse).

During the initial assessment when response dimensions competed, Kent allocated the majority of his time to the problems that produced more immediate access to reinforcement, even though they were associated with a lower rate of reinforcement (RvI), lower quality of reinforcement (QvI), and higher effort (IvE). Reinforcer immediacy was also an influential dimension when the QvI condition was replicated. Alternatives associated with higher quality reinforcers were favored when they did not compete with reinforcer immediacy (RvQ and QvE).

Self-control training. Self-control training baseline replicated the assessment condition for the two most influential dimensions (immediacy vs. quality), in which lower quality reinforcers available immediately after the session competed with higher quality reinforcers available the next day (24 hr later). Kent allocated a mean of 55% time to the more immediate, lower quality reinforcement alterative. When the delay to the higher quality reinforcer alternative was minimal (15 min), he allocated more time to that alternative; he continued to favor the higher quality alternative as the delay was systematically increased, ultimately to the previous baseline (24 hr) level (range, 51% to 99%).

Postassessment. In addition to reinforcer quality, Kent's time allocation was also influenced more by rate of reinforcement (90%) than by reinforcer immediacy following self-control training. He allocated his time equally between low-effort problems that produced delayed reinforcement and high-effort problems that produced immediate reinforcement.

Raoul

Assessment. During baseline when only one dimension differed in value across the two alternatives, Raoul's time allocation favored the alternatives associated with the higher rate, higher quality, more immediate reinforcement, and, to a lesser extent, less effort. During the initial assessment, he allocated the majority of his time to the problem alternative producing more immediate reinforcement when it competed with any other dimension except effort during the initial IvE condition. However, when effort and immediacy competed in the replication phase, he allocated the majority of his time to the problems producing more immediate reinforcement during both sessions. He allocated most of his time to the alternative associated with the higher rate of reinforcement when it competed with dimensions other than immediacy of reinforcement.

Self-control training. Self-control training baseline (24-hr reinforcer delay) replicated the assessment condition for the two most influential dimensions (immediacy vs. rate). As with this condition during the initial assessment and replication phases, Raoul's choices favored the alternative associated with more immediate access to reinforcers delivered at a lower rate; he devoted 100% of his time to that response option. When the delay to the alternative that produced the higher rate of reinforcement was minimal (15 min), he allocated more time to that alternative, and continued to do so as the delay was progressively increased to the baseline (24-hr delay) level (range, 83% to 100%).

Postassessment. Following training, Raoul also demonstrated self-control in allocating the majority of his time to the alternative producing the higher quality, more delayed reinforcers (92%). In the IvE condition, he continued to favor immediate access to reinforcement over low-effort problems (78% vs. 22%).

Lynn

Assessment. During baseline when only one dimension differed in value across the two alternatives, Lynn allocated 72% or more of her time to the alternatives associated with less effort and higher rate, higher quality, and more immediate reinforcement. During the initial assessment, she allocated the majority of her time to the problem alternative producing more immediate reinforcement when it competed with any other dimension. Quality was the most influential dimension when it did not compete with immediacy, and rate was more influential than effort.

Self-control training. Self-control training baseline (24-hr delay) replicated the assessment condition for the two most influential dimensions (immediacy vs. quality). As with this condition during the initial assessment and replication phases, Lynn allocated the great majority of her time (94%) to the problem alternatives associated with more immediate access to lower quality reinforcers. When the delay to the alternative producing the higher quality reinforcers was reduced to 15 min, she allocated more time to the higher quality reinforcer alternative, and (except for one session in the 45-min delay condition) continued to do so as the delay was progressively increased to 1 hr 15 min. When the baseline (24-hr) delay was reinstituted, she returned to favoring the immediate reinforcer alternative (73%), and continued to do so when the delay was subsequently reduced to 2 hr (56%). The delay was therefore reduced to the level at which she had previously demonstrated self-control (1 hr 15 min) and increased more gradually; she allocated the majority of her time to the higher quality delayed alternative throughout (range, 83% to 100%), and continued to do so when the maximum baseline delay (24 hr) was again introduced.

Postassessment. Following training, Lynn also demonstrated self-control in allocating the majority of her time to the alternative producing the higher rate delayed reinforcers (99%). In the IvE condition, she continued to favor immediate access to reinforcement (100%) over low-effort problems.

DISCUSSION

The results of the assessment showed that the choices of 3 students with ADHD were influenced principally by immediate access to terminal reinforcers relative to those that were delayed but of greater quantity and quality and that required less response effort to obtain. Thus, each of the 3 students demonstrated impulsivity, consistent with a diagnostic criterion for ADHD and with a conceptually systematic operational definition of that construct.

The assessment also yielded a profile of the relative influence of other dimensions, from which a competing dimension was identified (quality of reinforcement for Kent and Lynn and rate of reinforcement for Raoul); this was then used in combination with gradually increasing delays to establish self-control. Self-control was established more quickly (in fewer steps) for Kent and Raoul than for Lynn; however, for all 3 students, the results of the postassessment revealed that the self-control training procedure produced a shift in time allocation that favored both rate and quality of reinforcement over immediate access to reinforcement and response effort. This study therefore extends behavioral investigations of self-control (e.g., Dixon et al., 1998; Dixon & Holcomb, 2000; Schweitzer & Sulzer-Azaroff, 1988) by considering choices for delayed reinforcers in the context of dimensions in addition to the rate or amount of reinforcement (e.g., forgoing immediate reinforcers in favor of later access to those that are more highly valued or preferred). Basic research has suggested that fading procedures increase sensitivity to reinforcer amounts relative to reinforcer delays (Logue et al., 1984), and this might also apply to other dimensions such as reinforcer quality.

The study also contributes to research with humans on self-control with the use of tokens (in the form of points) as intervening stimuli prior to the exchange period (Stromer, McComas, & Rehfeldt, 2000). Most previous research with humans has investigated self-control and impulsivity with respect to the delivery of tokens or points. The present study differed in that we investigated the delay to the exchange period, which basic research, using analogues of self-control methods with humans, suggests is a more critical determinant of choice than delay to point presentation (Jackson & Hackenberg, 1996). The finding that self-control training resulted in completion of math problems associated with up to a 24-hr delay to the exchange period is significant considering authoritative assertions that, to be effective, token reinforcement "for those with ADHD . . . must be tied to more salient reinforcers that are available within relatively short periods of time" (Barkley, 1997, pp. 344–345).

In summary, the present study suggests that self-control in an analogue situation can be effectively established using a concurrent fixed-duration/progressive-duration delay procedure (Dixon et al., 1998; Dixon & Holcomb, 2000; Schweitzer & Sulzer-Azaroff, 1988) with a competing reinforcer dimension (Neef et al., 1993) identified through a brief assessment (Neef & Lutz, 2001b). The results also indicate that this approach to self-control training can produce transfer across untrained reinforcer dimensions (i.e., choices favoring greater quantity or quality of reinforcement over immediate access). However, the results must be interpreted cautiously in view of several limitations.

First, we used an abbreviated assessment because of practical considerations, including the limited time remaining in the school year, our desire to minimize the amount of time students spent away from the classroom, and the call by school personnel for assessments that are less time consuming. However, efficiency necessitated some sacrifice with respect to internal validity. The limited number of sessions per condition raises questions as to the stability of the assessment results and may not provide an adequate basis for distinguishing between-condition from within-condition variability.

Second, our investigation was limited to delays in relation to constant values of the competing dimension. Given the findings of basic research that relative sensitivities to reinforcer amount and delay differ as a function of the delay duration (Ito & Oyama, 1996), our results may have differed depending on the values of the competing dimensions. In addition, research suggests that different dimensions are multiplicative but not linearly equivalent in affecting choice (e.g., Logue et al., 1984).

Third, the results of training showing that choices representing self-control can be established with small delays that increase progressively were not subject to the controls of an experimental design. Fourth, we did not examine the extent to which impulsivity, as defined in this investigation, characterized the problem behaviors that contributed to the students' diagnosis of ADHD.

Similarly, although there is preliminary support for the treatment utility of this type of assessment for children with ADHD (Neef & Lutz, 2001a), our study does not provide information on the generalizability of the self-control training procedures or its effects in the students' typical environments. As a bridge investigation, its purpose was to extend basic research on the development of self-control to a population for which that goal is clinically important, using an educationally relevant task, but under conditions that allow greater control over extraneous variables than would be possible in typical classroom settings. Such research is preliminary to applied investigations that extend the methodologies or findings to effect changes in socially significant behavior occurring in everyday environments. Future research is needed to examine the applicability of the procedures and findings for promoting adaptive choices in those contexts. Continued investigation along this continuum may help to attenuate impulsivity as a threat to the social adjustment and educational success of children with ADHD.

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STUDY QUESTIONS

1. Contrast methods typically used to diagnose impulsivity with the way it has been operationalized in the behavioral literature.

2. Briefly describe the experimental task and the dependent variable.

3. What dimensions of reinforcement were compared, and how were they defined?

4. What criteria were used in selecting the "competing dimensions" used in self-control training, and which dimensions were chosen for each individual?

5. Describe the procedures used to establish self-control.

6. Explain the purpose of the postassessment and describe the results obtained.

7. What implications do these findings have with respect to Barkley's (1997) comment, "efforts to promote the development of self-control with these children [with ADHD] are therefore unlikely to be successful"?

8. What are some practical implications of the procedures used in the present study for the assessment and treatment of children with ADHD?

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